Characterization and Final Status Survey Plan For the Wet Weather Stream

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TABLE OF CONTENTS

1.0 INTRODUCTION

A radiological survey was performed during March of 1998 in the area known as the Wet Weather Stream on the Framatome Cogema Fuels' (FCF) Lynchburg Manufacturing Facility site in Lynchburg, Virginia. The survey consisted of: 1) high purity germanium (HPGe) *in situ* gamma spectroscopy measurements, of both general areas (i.e., averages) and areas of elevated radioactivity; 2) sodium iodide (NaI) gamma walkover surveys; and 3) collection and analysis of twenty soil/sediment samples. The results of the survey (ABB 1998) identified residual low-enriched uranium contamination in excess of applicable regulatory guidelines. Samples collected during the survey were split in the field and one set of split samples was provided to a U.S. Nuclear Regulatory Commission (NRC) inspector for independent evaluation.

Total uranium activity concentrations documented in the Survey Report were calculated by multiplying Uranim-235 *in situ* gamma spectroscopy results by a factor of 25, based on an assumed Uranium-235 mass enrichment of 4%. Based on the results of NRC contracted alpha spectroscopy analyses, a reevaluation of the conversion factor was performed which determined that a multiplier of 33 is more appropriate for calculating total uranium activity concentrations from Uranium-235. The *in situ* gamma spectroscopy results documented in the Survey Report have been revised to reflect this information. It should be noted that this Work Plan is based on the revised results.

2.0 AFFECTED AREA

A map of the Affected Area, as it was defined during the performance of previous radiological surveys, is shown in Figure 1. The following section of this document presents and justifies areas requiring no additional survey work, areas requiring further evaluation (i.e., characterization), and areas where the affected area will be expanded.

2.1 Areas Requiring No Additional Survey Work

During the March 1998 Survey a NaI gamma walkover survey was performed over 100% of the Affected Area, with the detector positioned within one inch of the ground surface, where possible. In addition, the average total uranium activity concentration in each grid was determined based on the results of *in situ* gamma spectroscopy measurements. In the majority of the grids that were surveyed, the gamma walkover survey did not identify any areas of elevated radioactivity and the average total uranium concentration and analytical sample results were less than 30 pCi/gram. FCF does not intend to perform any additional survey work in grids where, based on the results of the March 1998 Survey and sample results: 1) no areas of elevated radioactivity were identified; and 2) the average total uranium concentration is less than 20 pCi/gram. The data for these grids from the March 1998 Survey (as modified) will be used for determining their final radiological status. No additional sampling or surveys will be performed. Each of these grids are listed in Table 1 and illustrated on the Grid Map of the Affected Area, Figure 1.

2.2 Areas Requiring Further Evaluation

In many of the grids that were surveyed the average total uranium activity concentration exceeded the guideline value of 30 pCi/gram. In addition, sample analysis and hot spot *in situ* gamma spectroscopy measurement results indicate that total uranium concentrations in some localized areas exceed 90 pCi/gram, the maximum allowable concentration. Based on these facts, characterization surveys and possible remediation is required to demonstrate that these areas satisfy the guideline value.

Characterization surveys will be performed as described in Section 4.2 in grids where, based on the results of the March 1998 Survey (as modified) and sample results: 1) the average total uranium activity concentration exceeds 20 pCi/gram; and/or 2) hot spot sample analysis and/or *in situ* gamma spectroscopy measurement results indicate that total uranium concentrations exceed 90 pCi/gram. A total of 36 grids, identified in Table 2, meet these criteria and require additional evaluations. These areas are also illustrated on Figure 1.

Following the characterization surveys and remediation (as necessary), these areas will also be evaluated using the Final Status Survey techniques identified in Section 4.1.

2.3 Expansion of the Affected Area

The results of the March 1998 Survey indicate that the average total uranium activity concentration in some grids that form the perimeter of the current Affected Area is in excess of 30 pCi/gram and that one localized area in Grid R9 exceeds the 90 pCi/gram hot spot criteria. As such, the Affected Area will be expanded to include grids surrounding those areas. Specifically, the Affected Area will be expanded such that any grid with a average total uranium concentration near or exceeding 30 pCi/gram or a localized area exceeding the 90 pCi/gram hot spot criteria will be surrounded on all sides, including diagonals, by new grids or the currently defined Affected Area. In addition, three grids further downstream towards the James River will be established. Final status surveys will be performed in these grids as described in Section 4.1. It should be noted that if any of these grids fail to satisfy the guideline value during their final status survey, the Affected Area will be further expanded as described above, and the grid in question will be evaluated using the characterization survey model. Remediation will be performed as necessary following the characterization survey. Presently, the 40 new grid blocks will be added surrounding the original affected area. These grid are depicted in Figure 1 and listed in Table 3.

3.0 MEASUREMENT METHODS

The purpose of this section is to describe the radiological instrumentation and associated measurement techniques that will be implemented during the additional survey work.

3.1 Gamma Walkover Surveys

Gamma walkover surveys will be performed to identify areas of elevated radioactivity discernible above the ambient level. Such surveys will be performed using NaI detectors coupled to ratemeters which provide an analog count rate readout and an audible signal proportional to the count rate. Individuals performing the survey will move the detector back and forth as within one inch of the ground surface, where possible, and walk over the surface at a maximum speed of approximately 0.5 meters per second. The scan sensitivity of the gamma walkover survey is approximately 140 pCi/gram of total uranium based

on current NRC estimates in NUREG/CR-1507 (NRC 199x). It should be noted that this survey technique is identical to the gamma walkover survey performed during the March 1998 Survey.

3.2 HPGe *In Situ* Gamma Spectroscopy

HPGe *in situ* gamma spectroscopy measurements will be performed to determine the average total uranium activity concentration in the areas where measurements are performed. These measurements will be performed using a Canberra Industries *in situ* object counting system (ISOCS) with a 60% relative efficiency coaxial detector, or equivalent, positioned at a fixed height over the area being measured. The count duration for the HPGe *in situ* analyses will typically be 10 minutes per location which yields a detection sensitivity of approximately 7 pCi/gram of total uranium.

3.3 NaI *In Situ* Gamma Spectroscopy

NaI *in situ* gamma spectroscopy measurements will be performed to identify areas of elevated radioactivity and determine the extent of such areas. These measurements will be performed using a 3" x 3" NaI detector coupled to a multi channel analyzer. The detector will be positioned in contact with the ground surface or in a shallow hole such that the detector volume is just below the surface. The NaI *in situ* gamma spectroscopy system will be cross-calibrated in the field using the ISOCS HPGe *in situ* gamma spectroscopy system to determine its counting efficiency. This measurement technique provides the total uranium activity concentration in the localized area (i.e., a several inch diameter) surrounding the measurement location. The count duration for these measurements will range from one to five minutes yielding a detection sensitivity of less than 30 pCi/gram of total uranium.

4.0 RADIOLOGICAL SURVEY DEFINITIONS

This section defines the radiological surveys that will be implemented and the minimum requirements for those surveys.

4.1 Final Status Surveys

The purpose of this section is to describe the radiological surveys and minimum measurement frequencies that constitute a final status survey for areas identified in Sections 2.2 and 2.3. Survey methods are presented in the order that the surveys will be performed. It should be noted that these requirements do not apply to grids that do not require further evaluation, as defined in Section 2.1.

4.1.1 Gamma Walkover Survey

A gamma walkover survey will be performed as described in Section 3.1. The purpose of this survey is to identify areas of elevated radioactivity discernible above the ambient level. If areas of elevated radioactivity are identified, biased NaI *in situ* gamma spectroscopy measurements will be performed as described in Section 4.2.1 to determine if elevated measurements result from residual uranium, and if so, to quantify the residual uranium. If the results of these biased measurements identify total uranium in excess of 20 pCi/gram, a full characterization survey will be performed as described in Section 4.2, the surveys described in Sections 4.1.2 and 4.1.3 will not be performed, and the Affected Area will be expanded, if necessary.

4.1.2 HPGe *In Situ* Gamma Spectroscopy

Systematic HPGe *in situ* gamma spectroscopy measurements will be performed in each grid, as described in Section 3.2. The purpose of these measurements is determine the average total uranium concentration the grid. Systematic measurements will be performed at the center of each square quadrant in each grid, for a total of four measurements per grid. If any of the four measurements identify total uranium activity in excess of 20 pCi/gram, a full characterization survey will be performed as described in Section 4.2, the surveys described in Section 4.1.3 will not be performed, and the Affected Area will be expanded, if necessary.

4.1.3 NaI *In Situ* Gamma Spectroscopy

Systematic NaI *in situ* gamma spectroscopy measurements will be performed in each grid, as described in Section 3.3. The purpose of these measurements is to identify areas of elevated radioactivity, if present. These systematic measurements will be performed at 9 locations in each grid. These locations will be spaced in a square grid pattern at ten foot intervals, as shown in Figure III. If areas of elevated total uranium activity in excess of 20 pCi/gram are identified at any location, a full characterization survey will be performed as described in Section 4.2 and the Affected Area will be expanded, if necessary.

4.1.4 Grids Remediated as a Result of Characterization

Systematic NaI *in situ* gamma spectroscopy data collected during grid characterization and final biased post remediation NaI *in situ* gamma spectroscopy data, as described in Section 4.2.1, will be used for final grid status determination. As such, no additional NaI *in situ* gamma spectroscopy data will be collected. However, gamma walkover surveys and HPGe *in situ* gamma spectroscopy surveys will be performed as described in Sections 4.1.1 and 4.1.2, respectively.

4.2 Characterization Surveys

Section 2.2 identifies the criteria used to establish grids that currently require characterization surveys. The purpose of characterization survey is to identify and determine the areal extent of areas of elevated radioactivity and determine whether remedial actions are necessary, and if so, the scope of such actions.

4.2.1 NaI *In Situ* Gamma Spectroscopy

Both systematic and biased NaI *in situ* gamma spectroscopy measurements will be performed in each grid, as described in Section 3.3. The purpose of these measurements is to identify and determine the areal extent of areas of elevated radioactivity. Systematic measurements will be performed at 36 locations in each grid. These locations will be spaced in a square grid pattern at five-foot intervals. If areas of elevated total uranium activity in excess of 30 pCi/gram are identified, biased measurements will be performed to determine the boundaries of such areas.

The need for soil remediation will be determined based on the results of these surveys. If soil remediation occurs, biased measurements will be performed, post remediation, to determine the effectiveness of the remediation and the need for additional remediation. If additional remediation is performed, additional biased measurements will be performed. This process will be repeated until the remediation goals are reached.

5.0 DATA EVALUATION

Following the completion of the surveys described above, each of the grids in the affected area, including the additional 40 grid blocks added to the affected area, will be adequately characterized and remediated to levels below the guideline value. In addition to a careful review of the survey data, it is our intention to collect and analyze several biased and random soil samples for confirmatory analysis. At the request of the Nuclear Regulatory Commission, soil sample samples may be split for duplicate analysis by separate laboratories.

The survey plan outlined above includes a larger number of direct measurements than the work performed in March 1998. The increased number of measurements will provide the information necessary to demonstrate compliance with the guideline value for each grid block. In the event that localized areas above the guideline value are observed, the increased number of measurements will be useful in demonstrating that each contiguous $100m^2$ areas throughout the affected area are less than the guideline value.

Figure 1

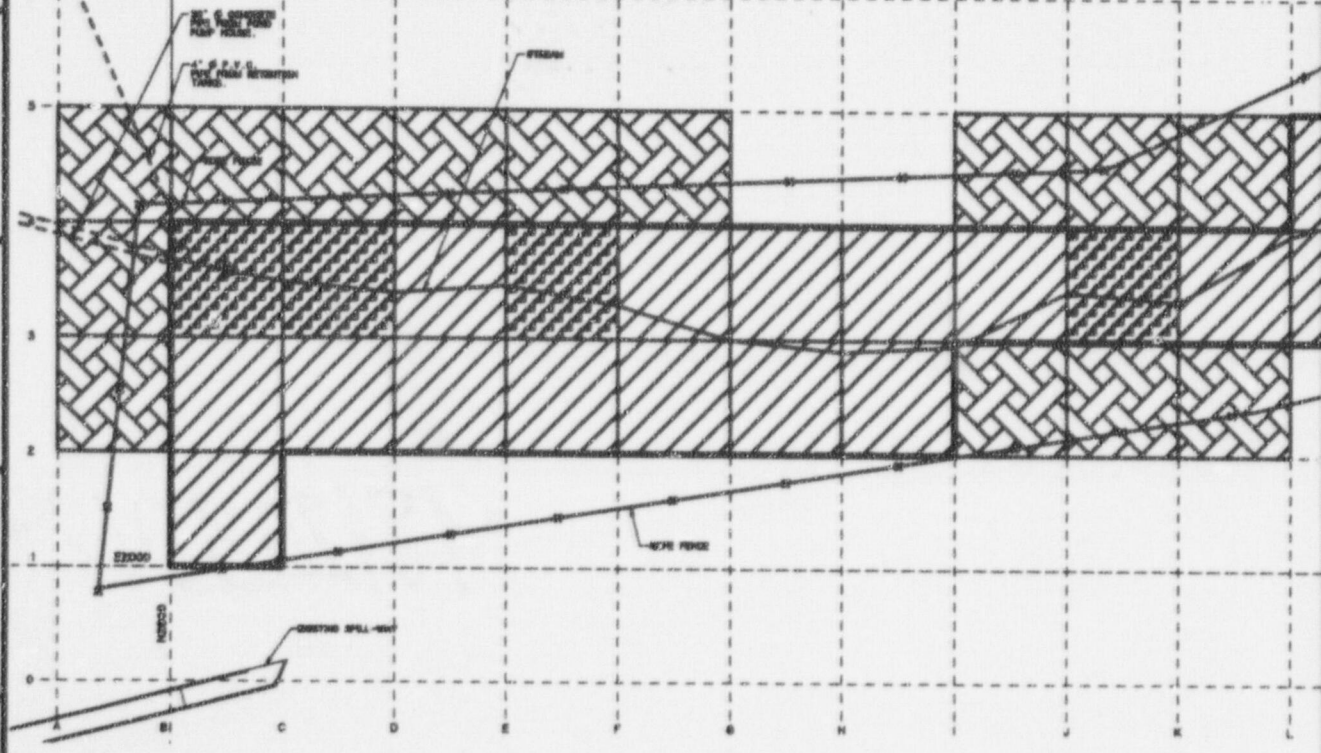
Map of the Affected Area

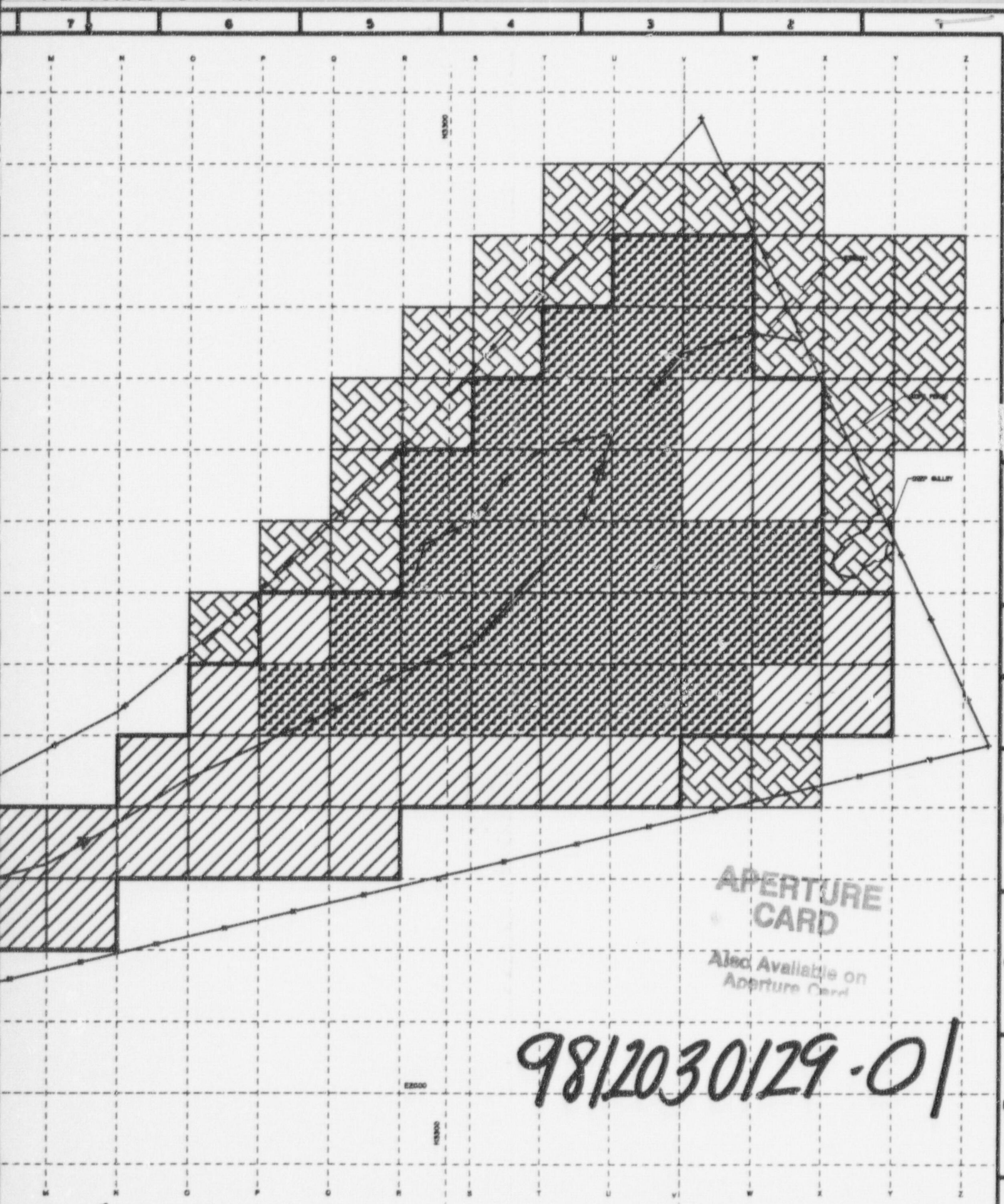
AREA CONSIDERED FREE OF CONTAMINATION. NO ADDITIONAL SURVEY TO BE PERFORMED.

AREA TO BE CHARACTERIZED AND REMEDIATED AS NECESSARY. FINAL STATUS SURVEY TO FOLLOW.

FINAL STATUS SURVEY TO BE PERFORMED.

GRID STATUS IDENFIFICATION KEY





9812030129-01

REV	DESCRIPTION	DATA	APPROVED
1	CHANGED TO SHOW GRID STATUS KEYS.	11/25/98	

REVISIONS

TOLERANCES

UNLESS OTHERWISE SPECIFIED

DISCHARGE STREAM CONTAMINATION SAMPLING GRID LAYOUT

PE-1451 E

Table 1

Grids Requiring No Additional Survey Work

B1	G2	M3	P7	W6
B2	G3	M4	Q4	W9
C1	H2	N4	Q5	W10
C2	H3	N5	R5	X6
D2	I3	O4	S5	X7
D3	J3	O5	T5	
E2	K3	O6	U5	
F2	L3	P4	V9	
F3	L4	P5	V10	

Table 2

Grids Requiring Characterization Survey

B3	C3	E3	J3	P6
Q6	Q7	R6	R7	R8
R9	S6	S7	S8	S9
S10	T6	T7	T8	T9
T10	T11	U6	U7	U8
U9	U10	U11	U12	V6
V7	V8	V11	V12	W7
W8				

Table 3

Additional Grids Added to Affected Area

A2	A3	A4	B4	C4
D4	E4	F4	I2	I4
J2	J4	K2	K4	O7
P8	Q8	Q9	Q10	R10
R11	S11	S12	T12	T13
U13	V5	V13	W5	W11
W12	W13	X8	X9	X10
X11	X12	Y10	Y11	Y12